on the lower side, lead smaller, well-marked veins. There is also a very slight point on the opposite side of the leaflet, the venation here being similar to that just described What, then, does this abnormal leaflet mean? Can we not see that nature has decreed that there shall be an increase in the number of leaflets? And that she is about to "cut off" new leaflets from each side of this terminal leaflet?

Fig. 2 confirms us in this supposition, and furnishes an objective demonstratian of a more advanced transition stage. The sinuses have deepened, and the two lobes bid fair to become separate individual leaflets. We feel secure in making this statement because Fig. 3 stands ready to make good our word with a newly-added leaflet on one side and another on the other side, well under way. The rachis, meanwhile, has elongated to make room for the new-comer. Fig. 4 illustrates a repetition of this process of division, adding emphasis to our explanation of these "abnormal leaves." Nature is going right on, bent upon working out her conceptions to the fullest extent.

Nos. 5, 6, and 7 are certainly extremists. They may, perhaps, be compared with the impulsive, rampant reformers in the social world, who are imbued with a stronger progressive impulse than will harmonize with existing conditions; whose wishes to surmount all obstacles and soar aloft lead judgment and reason astray. The time is not ripe for

LEAFLETS FROM THE AILANTHUS TREE.

such prodigious strides, and much effort is therefore expended to little purpose. A few such leaders will occasionally be found among plants, fore-runners, as it were, of future attainment, and here we have leaflets which as yet have not even attained to an individuality of their own, taking upon themselves the work which legitimately belongs to the senior members of the family; if we may designate a leaf as a little family, and the leaflets thereof the individual members. No. 8 is such a senior member; that is, instead of a terminal leaflet it is from the base of the leaf. It is better able to take up the burden of secondary division than the mere baby leaflets that have not yet learned to take care of themselves. No. 8, however, may also be classed with the reformers, but with that more reasonable class who are not entirely beyond the ken of normal vision.

Would we not, therefore, be led to draw this conclusion from what we have said (and, I trust, demonstrated), that pinnate leaves are developed by a division of the terminal leaflet: the bi-pinnate leaf is evolved from the pinnate by the division of the leaflets, normally beginning in the lower or basal leaflets? That this is the law of division which holds among the majority of pinnate leaves is quite commonly demonstrated and verified by the leaves of various plants. The leaves of the trumpet creeper furnish as good illustrations of these various stages of transition as the ailanthus leaves.

There is but a slight point on the lower or outer portion of the typical basal leaflet of the ailanthus; this point is crowned with a small gland; here seems to be the starting-point of the new departure, which, according to the prediction of No. 8, will, in the course of time, result in the evolution of a bi-pinnate ailanthus leaf. This secondary division, as we have chosen to call the division of the lower leaflets, is illustrated abundantly by the common elder (*Sambucus canadensis*). So conspicuous, indeed, are the variations in the elder that it deserves a chapter on its own progressive efforts; it seems especially able to respond to favorable conditions.

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SUGGESTIONS AS TO TEACHING BOTANY IN HIGH SCHOOLS.

THE teaching of botany in our colleges and higher schools during the last twenty-five years has had the unfortunate effect of bringing the science into disrepute, and of engendering in the minds of many who — as they would say — "took" it (like a dose of medicine), a thorough distaste for it. It is only within ten years that any radical change has taken place in the teaching ideals, and even to-day in many of the best institutions of learning, conservatism forces instruction into the old channels. The lower schools have travelled the same line, partly because they knew no better way, and partly because they were meeting the demands of the higher schools in the matter of preparation.

The radical defect of the older teaching lay in the failure to study the plants themselves; in the failure to treat them as living organisms; and in the failure to take into account the existence of other plants than the flowering ones. The ease with which plants could be collected and preserved by drying early led to the study of their external characters with a view to their classification alone. From the earliest times, therefore, almost to the present day, classification has been looked upon as the most important portion of the science of botany. Now, however, that the economic importance of the study of the physiology of healthy and diseased plants and of the causes of disease is coming to be more generally appreciated, it is high time that both in primary and secondary schools those portions of the science be taught which have a vital and vitalizing interest.

What Text-Book Shall We Use?

The first question that is usually asked is, "What text-book shall we use?" It is a difficult question to answer, and probably the best reply is, "Whatever text-book the teacher can use best." There is no book known to me which presents the subject in just the way that I consider most important. Probably the one of most general adaptability is "Gray's Lessons in Botany." If the teacher is capable of using them, either Bessey's "Essentials of Botany" or Campbell's "Structural and Systematic Botany" may be recommended. Wood's "Lessons in Botany," revised, is unfit for use on account of the numerous and misleading blunders which it contains. There should be in the school library, for reference, Gray's "Structural and Systematic Botany," Goodale's "Physiological Botany," Bessey's "Botany," and Goebel's "Outlines of Classification." Miss Newell's "Outline Lessons in Botany" will be found suggestive to the teacher who knows nothing of the method of study suggested herein.

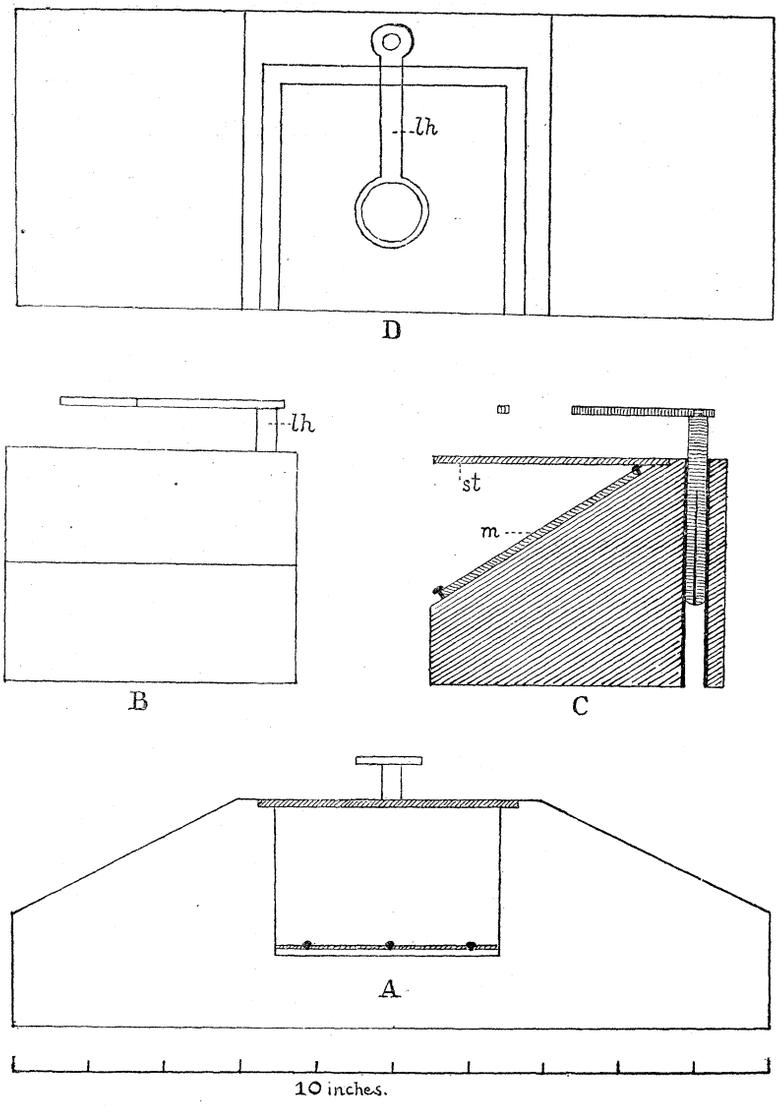
The suggestions here made are based on the supposition

that the scheme of studies proposed by the State superintendent is accepted, in which two terms are assigned to botany, beginning in the winter term. It is also presupposed that the School Board will be willing to supply the pupils with a proper room and a small amount of apparatus. I consider the providing of these quite as indispensable for the study of botany as furnishing a recitation room for mathematics with a blackboard and its accessories.

The room should be furnished with a sufficient number of common kitchen tables (those with unfinished tops are best), at which two students can work comfortably, and even four if crowded. The more windows the better.

The apparatus required is simple. Simple lenses with some device for supporting them while the hands are used in dissecting are needed. The figures annexed show a most effective and low-priced dissecting stand which is in use in the University of Wisconsin and is to be preferred to more expensive ones. The block can be made by a carpenter for a few cents; the plain and mirror glass can be procured at the glazier's; the lenses and lens holders can be procured from the Bausch & Lomb Optical Co., Rochester, N.Y. The total cost should not exceed $1.75. If preferred, they may be procured of Mr. L. S. Cheney, Madison, Wis., at $1.75 for single stands, with a discount of ten per cent on orders for ten or more.

A deep individual butter dish is necessary for examining specimens in water. Each student should have a pair of needles (No. 6, "sharps") with the eye-end driven into soft pine handles. This can be done by holding the needle with a pair of pliers and forcing it in. The pupil should be required to provide himself with a sharp-bladed pen-knife, a rarer article than might be supposed.



DISSECTING MICROSCOPE.

The body is a solid block of clear pine, cut as shown in *A*, front view; *B*, end view; *C*, median cross section; *D*, top view. *lh*, lens holder, which slides in brass tube driven into a hole in block (sec. *C.*); *st*, stage, a movable glass plate; *m*, mirror, fastened with small screws or tacks.

How to Get Material.

I should begin with a study of the flowering plants. There will be room for the exercise of some ingenuity in getting pupils to provide proper material for study by raising some and collecting some. Lima beans, sunflowers, and corn can be grown in pots or boxes; window gardens, greenhouses, and provision stores can be levied on until the spring opens. But it is better to have material collected in the summer and preserved in alcohol. Such material should be studied in water to prevent drying and to remove brittleness.

How to Begin.

It matters little what part is selected for a beginning. As the study commences in winter, the shoots of trees, two or more feet long, may be used. Select a tree in which the scars left by the fall of the foliage, leaves, and bud scales of the preceding season are quite conspicuous, such as the cottonwood, poplar, hickory, or horse-chestnut. Set the students at work to examine these before they have been assigned any study in the book. Have them examine all the markings they can find; compare the buds; study the relation between the buds and the scars; determine the extent of the preceding season's growth and of the season before that. When as much of the external anatomy has been seen as possible, let them carefully dissect the buds, studying the nature and shape of the scales; the character of their surfaces, whether hairy or resinous; the young foliage leaves for the next season; the young stem, comparing the shoot for the coming season with last season's growth, noting differences and resemblances. This dissection should be made partly by tearing off the parts, partly by cutting thin slices crosswise and lengthwise with the knife.

When the students have seen everything that they think there is to be seen, let them write a description of what they have observed. They should be asked to make this description as terse as possible, using their own language and not resorting to the book for terms.

The teacher should then examine these descriptions, in which he will doubtless find much omitted. I should then make the study of the same shoot the subject of the next class exercise, in which I should point out each feature that I wished examined, giving sufficient time for the inspection of each part. I should also endeavor to show that for the circumlocutions in their descriptions there are often single words (technical terms). The pupils will thus come to know something of the method of accurate and thorough observation, and will discover that technical terms are not hard words invented for their discomfiture, but short ways of expressing the ideas gained.

At the close of this exercise I should call upon each pupil to draw carefully a portion of the shoot showing as many of the facts observed as possible. Drawings should also be made of the dissected parts. Here the teacher will be met by the objection on the part of the pupils that they cannot draw; but as that is only another way of saying that they cannot see accurately, he will have to insist on their doing the best they can, with the assurance that as power of accurate observation increases the accuracy of the drawings will increase in the same ratio. He should be able to lead here as at other difficult places. Happy he if he be not a blind leader of the blind.

After studying several other shoots in the same way, I should assign the lesson in the text on buds and branching.

The points specially emphasized here are: 1. Study of the plants themselves. 2. Drawing and describing observations. 3. Afterwards the study of the text-book. 4. Supplementary reading, particularly as to the function of the parts studied.

Topics for Further Study.

Following this method with each organ, the following topics are suggested:

Underground stems: potato (tuber); onion (bulb); cyclamen or Indian turnip (corm).

Structure of stems: cut thin slices of both herbaceous and woody stems and examine in water. Bean, sunflower, geranium, hyacinth, and twigs of forest trees may be used.

Leaves: structure of blade and petiole; forms of stipules; character of venation, particularly with reference to function of veins. Reference readings on the function of foliage leaves are particularly important. Study of the unfolding leaves in spring is specially desirable.

Flowers: parts; forms; flower clusters, etc. I need enter on no details as to these parts, since they are treated so fully and have always received overmuch attention because of their importance to classification.

Let it be remembered in the study of all these topics that it is not a memorizing of the technical terms of descriptive botany that is wanted, but a study of structure of the parts with reference to function. Insist on the pupil constantly asking himself, "What is this for?" As to technical terms; if they are not acquired as a convenience they would better not be acquired at all.

Some time should be taken before the close of the year to study the lower plants. It is an excellent plan in the spring to organize "forays," on which pupils can collect every form of plant they can lay their hands on, ferns, toadstools, lichens, parasitic fungi, algæ, etc. Preserve these[1] and have them studied. Directions for such study can be found in Arthur, Barnes, and Coulter's "Plant Dissection" (Henry Holt & Co.); Bower's "Practical Botany" (Macmillan & Co.); Bessey's "Essentials of Botany" (Holt); Campbell's "Structural and Systematic Botany" (Ginn & Co.).

Questions will be freely answered regarding any matters not elucidated above, and further suggestions will be made if desired. I should be glad to be of assistance to teachers in improving the work in botany.

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A NEURO-EPITHELIOMA OF THE RETINA.[2]

THE possibility of the reproduction of the most highly organized structure of the human body has long been doubted and even denied. Until the publication of an instance by Professor Klebs of Zurich, in which the ganglionic cells of the central nervous system were found repeated in a tumor formation, this was not admitted to be possible. Even now not a few competent pathological histologists are not convinced of its occurrence. An interesting and important addition to this subject is that of Dr. Flexner. In this instance the rod and cone layer and the external nuclear layer of the retina were reproduced in a tumor.

The case was that of a child four months old. One eye was affected and removed, and then the remaining eye became the seat of a disease presumably of like nature. But nothing was permitted to be done for the second eye. Several years before this child was born another child in the same family, this one six months old, died in consequence of an eye tumor which returned. Two years after the case just related another child of the same parents, this one four months old, had a tumor of the eye which spread to the brain, also resulting in death. The one which is reported makes, therefore, the third instance of eye tumor in this family. There was no history of eye tumor in the immediate ancestors of the children.

The vitreous chamber of the eye was filled almost entirely with the growth, The latter was attached to the retina throughout a considerable part of its extent, and was seen to originate at a point of microscopical size situated in the external nuclear layer. The cells which made up the tumor consisted of two principal kinds.

[1] Every teacher should have some book with directions for preserving plants. The following are available: Bailey's "Collector's Hand-book" (Bates, Salem, Mass.); Penhallow's "Botanical Collector's Guide" (Renouf, Montreal); Knowlton's "Directions for Preserving Recent and Fossil Plants" (Part B, Bulletin 39, U. S. National Museum).

[2] "A Peculiar Glioma (Neuro-epithelioma?) of the Retina," by Simon Flexner, M.D., fellow in pathology. From the Pathological Laboratory of the Johns Hopkins University and Hospital. The Johns Hopkins Hospital Bulletin, No. 15, 1891.